Description of a New, Giant *Ataxocerithium* Species from Australia with Remarks on the Systematic Placement of the Genus (Prosobranchia: Cerithiopsidae)

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ABSTRACT

A new, large *Ataxocerithium* species is described and given the name *eximium*. This new species differs considerably in shell characters from any other known *Ataxocerithium* species. Shell characters, the radula, and anatomical characters, such as an acrembolic proboscis, suggest *Ataxocerithium* be assigned to the Cerithiopsidae. Comparison of the new species with other taxa is made and a brief discussion of the genus is presented.

INTRODUCTION

The genus *Ataxocerithium* Tate, 1894 is not well known. The limits and systematic position of the genus are poorly understood, and the anatomy is undescribed. The genus usually has been allocated to the Cerithiidae Ferussac (Cossmann, 1906:92; Thiele, 1929:212; Wenz, 1940:759; Powell, 1951:111; Cotton, 1959:361; Iredale & McMichael, 1962:44), and recently to the Cerithiellidae Golikov and Starobogatov (Marshall, 1978:60). A cursory examination of the many species attributed to this taxon suggests that *Ataxocerithium, sensu lato*, probably comprises several genera. The alpha taxonomy of this group has not been accomplished; consequently, the full extent of this radiation is not known nor is the geographic distribution of the group and its component species understood.

While studying Pacific and Indian Ocean *Ataxocerithium* species, specimens of a large, distinctive, undescribed species, dredged in deep water off Sydney, New South Wales, Australia were examined in the Australian Museum, Sydney. Much of the material was preserved in alcohol and, although the body whorls were poorly preserved, was suitable for dissection and study of the radula, operculum, and gross anatomy. Unfortunately the state of the pallial gonoducts was not able to be determined. The gross anatomy of another species, *A. scrupulosum* Iredale, 1936, was also examined and compared with the new species, and a tentative diagnosis of *Ataxocerithium* was formulated. Most *Ataxocerithium* species have relatively small shells, not exceeding 20 mm in length. The discovery of this large, distinguished species enriches our concept of this group and thus merits a full description.

MATERIALS AND METHODS

Material examined: A total of 21 specimens were examined (AMS = Australian Museum, Sydney): R.V. *TANGAROA*, Sta. U220, 32°59′S, 152°33.5′E, 381–444 m, off Newcastle, NSW (AMS c142398, c142391); R.V. *TANGAROA*, Sta. U208, 34°13.8–15.8′S, 151°26.6′–29.1′E, 381–395 m, S of Sydney, NSW (AMS c142391); FRV *KAPALA*, 39°45′S, 151°49–50′E, 439 m, off Sydney, NSW (AMS c142392); FRV *KAPALA*, Sta. K75-12-06, 34°16–21′S, 151°24–28′E, SE of Botany Bay, NSW (AMS c142394, type-lot); FRV *KAPALA*, Sta. K75-05-07, 412 m, 34°28–34′S, 151°17–19′E, E of Pt. Kembla, NSW (AMS c142396); FRV *KAPALA*, Sta. K75-12-07, 421 m, 33°43–48′S, 151°48–51′E, E of Sydney, NSW (AMS c142395); FRV *KAPALA*, Sta. K75-12-05, 34°32–39′S, 151°15–19′E, 412 m, E of Kiama, NSW (AMS c142393) (all Australia).

Methods: Three specimens were extracted from their shells, dissected, and examined under a Wild M-8 dissecting microscope. Only the head-foot and lower mantle cavity were well preserved. Radulae, protoconchs, and opercula were studied with electron microscopy using a Zeiss Novascan-30 instrument. The shells of all 21 specimens were studied, but as many of these were damaged or immature, only seven adult, complete shells, with fully developed apertures, were measured to establish the range of variation (Table 1).

SYSTEMATIC RESULTS

Superfamily **Cerithiopsacea** H. and A. Adams, 1853
Family **Cerithiopsidae** H. and A. Adams, 1853

Genus *Ataxocerithium* Tate, 1894

Diagnosis: Shell turreted, whorls inflated, sculptured with axial ribs and spiral cords. Body whorl wide with

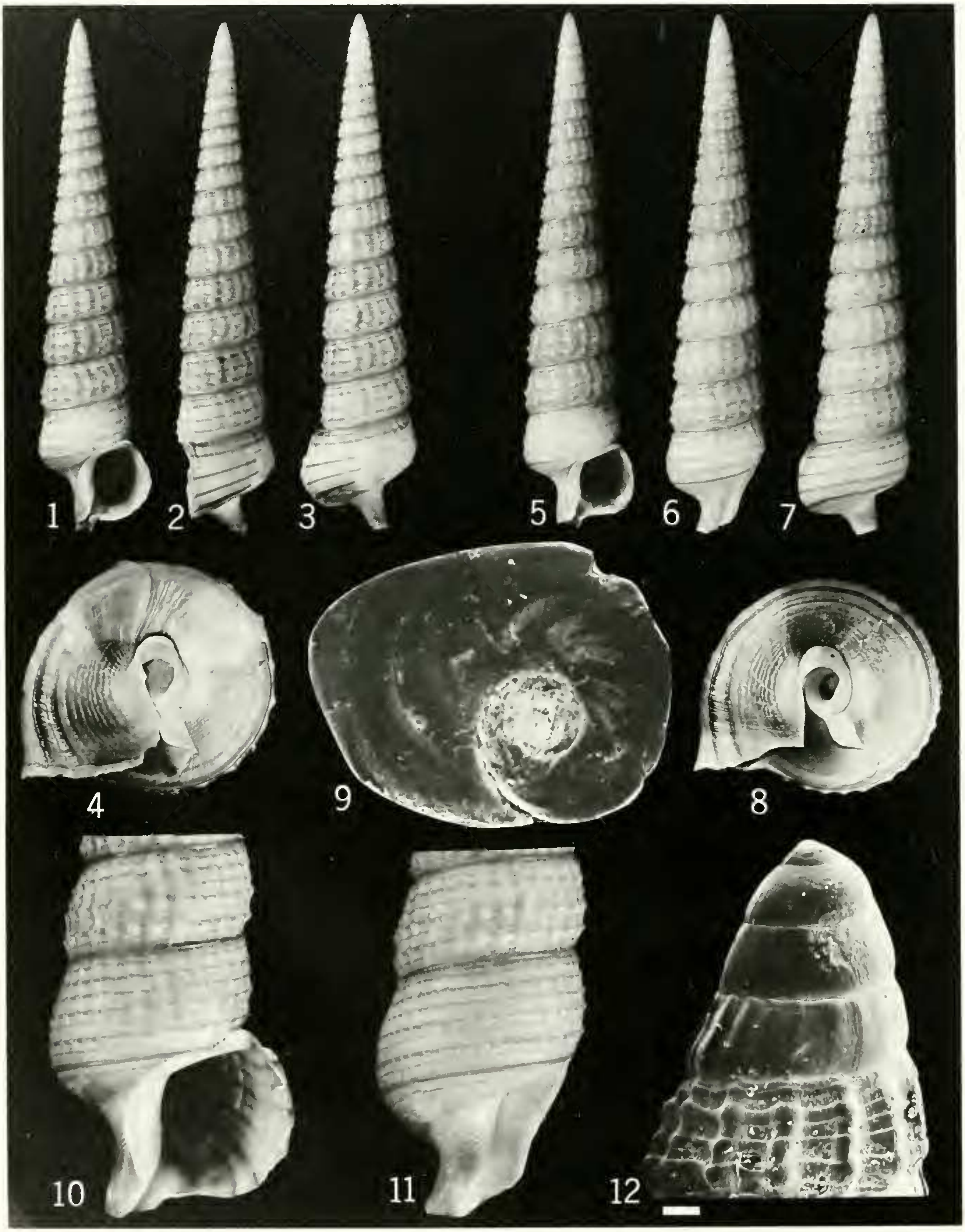
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Table 1. Range of measurements in seven adult shells of *Ataxocerithium eximium* new species.

Statistic	Length	Width	Aperture length	Aperture width	No. axial ribs	No. spiral cords	No. whorls
$\bar{x}$	43.2	9.5	6.8	5.9	22.7	4.7	20.7
SD	2.67	0.51	0.37	0.59	2.5	1.3	0.49
Range	40.1–46.3	8.7–10.1	6.5–7.2	4.9–6.6	20–27	5–6	20–21

flattened base and short, tubular anterior canal. Aperture ovate, with large columellar lip that joins base of outer apertural lip forming nearly complete peristome. Operculum corneous, ovate, paucispiral with subcentral nucleus. Foot with deep, anterior mucus gland, long, deep, longitudinal cleft; sole demarcated from foot by deep groove. Mantle edge smooth. Taenioglossate radula with long, brush-like denticles on tip of marginal teeth. Cuticular anterior esophagus in some species. Acrembolic proboscis and large esophageal gland present.

Ataxocerithium eximium new species
(figures 1–16)

Diagnosis: Large, thin, high-spired shell with cancellate, prickly sculpture due to 5 thin, beaded, spiral cords crossed by numerous collabral axial riblets. Thin, golden-tan spiral lines overlay silky-cream finish. Aperture ovate-circular with high concave columellar lip closely adpressed to lower outer lip. Long tubular anterior canal. Foot with deep longitudinal cleft. Sole separated from foot by deep cleft around its circumference. Columellar muscle long, strap-like. Osphradium a tall ridge. Acrembolic proboscis with short introvert, large jaws, cuticular anterior esophagus, long buccal mass, and long, taenioglossate radula. Esophageal gland large.

Description: *Shell (figures 1–8, 10–12; table 1):* Shell long, high-spired, slender, reaching 46.3 mm in length and 10.1 mm in width, and comprising 20–21 moderately inflated whorls. Protoconch (figure 12) of 3 smooth, inflated whorls, earliest one pointed. First teleoconch whorl sculptured with numerous axial riblets. Teleoconch (figures 1–3, 5–7) sculpture of overall cancellate, prickly, rasp-like, appearance due to 5–6 spiral cords crossing over numerous, collabral, axial riblets. Pointed beads appear where axial riblets cross spiral cords and are aligned colabrally in opisthocyrt growth lines. Earlier teleoconch whorls (figure 12) dominated by wide axial ribs and 4 weak spiral cords. Later teleoconch whorls have 7 spiral cords, 3 of which are major and 4 minor. Minor cords are on interspaces between major cords. Axial riblets less pronounced on later whorls. Penultimate whorl with 20–27 axial riblets and with fine spiral threads on first 2 adapical interspaces between major spiral cords. Suture distinct, straight, bordered with presutural and postsutural smooth, spiral cords. Body whorl (figures 10, 11) with 7 weakly beaded, nearly smooth spiral cords and fine axial growth lines. Siphonal constriction at whorl base (figures 10, 11) with numerous, fine spiral striae. Aperture (figure 10) ovate-circular, slightly longer than wide, and a little more than one-fifth the shell length. Columella concave with high columellar lip (figure 11). Anterior siphonal canal long, tubular, reflected to left of shell axis and tightly constricted from the aperture where base of columellar lip meets base of curved, convex outer lip (figure 4). Outer lip smooth and thin. Border of outer lip and columellar lip form subcircular aperture mouth. Shell color silky cream, the spiral cords a golden-tan-orange color with white beads, the suture defined by broader golden-tan, spiral cord. Periostracum not evident. Operculum (figure 9) thin, corneous, brown and paucispiral with subcentral nucleus.

Radula (figures 13–16): Radular ribbon taenioglossate, long, about $\frac{1}{12}$ the shell length. Rachidian tooth (figure 15) with square basal plate, pair of tiny basal cusps, and straight base. Anterior face of rachidian tooth strongly convex. Cutting edge with sharp, central, major cusp flanked on each side by four tiny denticles. Lateral tooth (figures 14, 15) large, robust, roughly rectangular shaped, with thick central shaft and supporting longitudinal ridge. Tip or main cusp of lateral tooth large, pointed, flanked by strong inner buttress-like cusp and with 2–3 tiny, sharp, outer denticles. Basal plate of lateral tooth broad with pointed, outer, posterior corner and longitudinal basal butress ending in slight bulge. Outer front edge of lateral tooth with medial-basal flange. Marginal teeth (figure 16) long, rod-shaped, with broad bases, brush-like apices, and long, sharp tips. Inner marginal tooth

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Figures 1–12. *Ataxocerithium eximium* new species. **1–3.** Holotype, AMS C142394 (45.7 mm length), showing apertural, right lateral, and dorsal views. **4.** Shell base of holotype, showing close apposition of columellar lip and outer lip base (figure length 10.5 mm). **5–7.** Paratype (USNM 862328, 41 mm length), showing apertural, left lateral, and dorsal views. **8.** Shell base of paratype. **9.** Free side of operculum (4.3 mm length). **10.** Detail of aperture and body whorl, showing large columellar lip, long anterior siphon and cancellate whorl sculpture (figure length, 15 mm). **11.** Left lateral detail of body whorl showing extended columellar lip and cancellate whorl sculpture (figure length, 15 mm). **12.** SEM of papillate, smooth protoconch and early sculpture of first teleoconch whorls (bar = 200 μm).

Figures 13–16. Radula of *Ataxocerithium eximium* new species. **13.** Radular ribbon with marginal teeth folded back to show rachidian and lateral teeth (bar = 20 μm). **14.** Radular ribbon tilted to expose undersurfaces of rachidian and lateral teeth (bar = 20 μm). **15.** Details of rachidian and lateral teeth (bar = 10 μm). **16.** Details of marginal teeth showing brush-like tips (bar = 10 μm).

apex with 5 inner flanking, needle-shaped denticles and 2–3 sharp, outer flanking denticles. Outer marginal tooth same, but with only 1 outer flanking denticle.

Animal (figure 17): Preserved animal pink. Foot long, separated from sole by wide, deep furrow around its entire edge (figure 17, fs). Propodium broad, crescent shaped anteriorly, and with dorsal surface pigmented dark brown. Deep propodial mucus gland at leading edge of sole (figure 17, pmg). Sole of foot light pink and with many transverse wrinkles; divided longitudinally by deep cleft (figure 17, cs) that begins just behind propodial mucus gland. Head has broad, short, muscular snout (figure 17, sn) with bilobed tip and mouth (figure 17, m) leading to large introvert. Pair of long cephalic tentacles (figure 17, t) each with large eye (figure 17, e) at outer peduncular base. Eyes black with red center. Mantle edge (figure 17, me) smooth. Very long, strap-like columellar muscle extends posteriorly for 5.5 whorls. Mantle cavity large, spacious. Osphradium a long, high, narrow, white ridge, slightly swollen at its base and thinly tapered at its dorsal edge. Ctenidium large, adjacent to osphradium and comprised of long, finger shaped, triangular filaments. Hypobranchial gland moderately developed. Rectum wide. Pallial gonoduct thick and glandular. Acrembolic proboscis present: Introvert short, somewhat cuticular interiorly; separated from opening of mouth by circular band of muscles. Pair of large (1 mm long), oval-rectangular jaws with scaly surface in oral cavity. Buccal mass elongate and with long, taenioglossate radular ribbon, which emerges distally from beneath right side of buccal mass, crosses over it and lies on left side of esophagus. Anterior esophagus appears to be cuticularized. Pair of large, orange, ascinous salivary glands present; left gland larger and extends partially through nerve ring; right gland smaller, and lies anterior to nerve ring. Large mid-esophageal gland with inner epithelium thrown into many thin transverse filaments that appear to extend the entire esophageal circumference. Nervous system epiathroid. Thin, short, but distinctive connectives between cerebral and pleural ganglia. Right pleural ganglion about one-half the size of right cerebral ganglion and with long supraesophageal connective. Left pleural ganglion with short connective to subesophageal ganglion. Long connectives join pleural ganglia to anteriorly located pedal ganglia.

Holotype: AMS C142394, length 45.7 mm, width 10.1 mm; 5 paratypes, AMS C153005; 2 paratypes, USNM 862328.

Type locality: Dredged 421 m, 34°21–16′S, 151°24–28′E, SE of Botany Bay, NSW, Australia.

Etymology: From the Latin adjective, *eximius, a, um*, distinguished, extraordinary.

DISCUSSION

This large, many-whorled, unusually sculptured species is the largest known *Ataxocerithium* species, and not easily confused with any other congener. Four other nominate sympatric species of *Ataxocerithium* occur off New South Wales (Iredale & McMichael, 1962:44), and these are all appreciably smaller. The high spired shell and silky-cream ground with its thin, golden-tan, spiral lines, and the fine, prickly, cancellate sculpture (figures 10–12) readily distinguish *A. eximium*. The highly tureted cerithiid species, *Cerithium matukense* Watson, 1886, looks very much like *A. eximium*, but differs in having weaker collabral axial riblets, straight sided whorls, and lacks the protruding columellar lip joining the lower outer lip, and the smooth papillate protoconch of the latter taxon. *Ataxocerithium eximium* does not appear to vary much in sculpture (see table 1), but the only known specimens are all from a narrow locale.

Ataxocerithium eximium, to date, has been dredged on soft bottoms in depths of about 380–450 m, from a narrow geographic range off the coast of Sydney, New South Wales. It probably occurs in similar habitats and depths along the southeastern Australian coast. Some shells are covered by a thin growth of sponge. The rectum was filled with gray sediment and detritus comprising arthropod appendages, bryozoan pieces, foraminiferans, sand grains and sponge spicules. This species probably lives and feeds on sponges, as does *Ataxocerithium scrupulosum* Iredale, 1936, which has been collected on sponges by SCUBA divers (Ian Loch, personal communication). Most cerithiopsids appear to be sponge feeders. No drilled shells have been seen. Shells frequently have broken apertures suggesting predation by crabs or fish.

Ataxocerithium eximium differs so much from any other congener that it might be considered representative of a new genus. While there appear to be major differences in shell and radular morphology among various *Ataxocerithium* species (personal observation), the group has never undergone revision nor has the internal anatomy been seriously studied. Although I have examined the anatomy of two species, all species are best referred to *Ataxocerithium, sensu lato*, until the group is more comprehensively known.

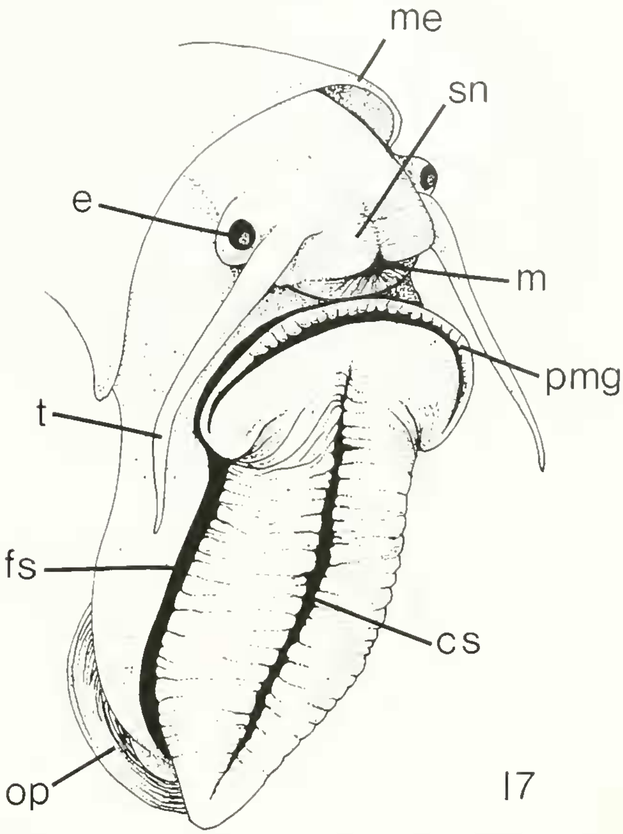

Figure 17. Head-foot of *Ataxocerithium eximium*. Abbreviations: cs = longitudinal cleft in sole of foot; e = eye; fs = furrow separating foot from sole; m = mouth; me = mantle edge; op = operculum; pmg = propodial mucus gland; sn = snout; t = cephalic tentacle.

Powell's (1951:191, fig. 1 (34)) figure of the radula of *Ataxocerithium pullum* (Philippi, 1845), the only other published figure of the radula of an *Ataxocerithium* species known to me, resembles the general morphology of the rachidian and lateral teeth of *A. eximium* shown herein, although the marginal teeth of *A. pullum* look quite different. I have studied the radula of another *Ataxocerithium* species from Natal, South Africa, in which the radular teeth differ in shape and cusp number from those of *A. eximium*, in every aspect. Thus, there is probably a wide range of variation in radular morphologies in this group.

Although most authors have placed *Ataxocerithium* in the Cerithiidae, the radula of *A. eximium* is more indicative of those of cerithiopsids (superfamily Cerithiopsacea). However, as mentioned above, *Ataxocerithium* radular morphology is variable. Marshall (1978: 60) stated that his preliminary studies of Australasian species of *Ataxocerithium* suggest that the genus should be referred to the Cerithiellidae Golikov and Starobogatov, 1975, but presented no supporting data. The Cerithiellidae is a poorly defined group: to my knowledge, no author has listed the apomorphic characters defining this group or has established its familial status with any supporting data. The radula of *Cerithiella metula* Loven, as depicted by Sars (1878: table 7, fig. 4), differs markedly from that of *A. eximium* in lacking the pair of basal denticles and in having fewer cusps on the cutting edge of the rachidian tooth. In *A. eximium*, the base of the lateral tooth is much longer and has a basal ridge; moreover, the marginal teeth are long and with brush-like tips, while they are simple, short hooks in *Cerithiella metula*. Marshall (*in litt.*) has suggested that the two large cusps on the lateral tooth of *Ataxocerithium* and *Cerithiella* are homologous and that the *Cerithiella* radula originated by reduction from an *Ataxocerithium*-like plan, but available data on both taxa are too few to allow anything other than speculation about radular evolution, at this point. Marshall (1980:85) subsequently regarded the Cerithiellidae as a subfamily of the Triforidae Jousseaume (Cerithiopsidae). The Triforidae, largely based on shell characters, is another poorly defined, higher category taxon, which lacks the salient autapomorphies necessary for familial status. While agreeing with Marshall's proposed scheme of relationships, I disagree with the ranking. As so little is known about the taxa *Cerithiella* and *Triforis* Deshayes, other than conchology, it seems premature and non-parsimonious to accord them familial or even subfamilial status. They are best regarded as higher category taxa of uncertain status within the Cerithiopsidae.

The protoconch (figure 12) of *Ataxocerithium eximium* is quite different from the protoconch of the *Ataxocerithium* species depicted by Marshall (1980:86, fig. 1, F), which closely resembles that of a *Triforis* species depicted in the same figure. It seems that there is wide variation in *Ataxocerithium* protoconch morphology. Marshall (1978:54) has pointed out the extreme diversity of cerithiopsid radulae.

The longitudinal cleft in the sole of the foot of *A. eximium* is exactly like that of *Cerithiopsis powelli* Marshall, 1978 [Marshall (1978:53, fig. 2)] (Cerithiopsidae), and very much like that depicted by Marshall (1977: 113, fig. 1, A) for *Metaxia exaltata* (Powell, 1930) (Triphoridae), and *Seila adamsii* (Lea, 1845) (Triphoridae), which I have dissected. The anatomy of the anterior alimentary canal of *A. eximium* (cuticularized anterior esophagus) and *A. scrupulosum* differs from that of other described cerithiopsids by the presence of a short, but well-developed snout. Otherwise, it is similar in layout to the alimentary canal of *Cerithiopsis* species (Cerithiopsidae), as described by Fretter (1951:567–576), and not unlike that of *Mastonia* species (Triphoridae), described by Kosuge (1966:303–305). The layout of the nervous system of *A. eximium* is also similar to that described for *Mastonia* (Kosuge, 1966:305). Thus, *Ataxocerithium* species appear to share characters found in cerithiopsids and triphorids, but have more in common with cerithiopsids. Anatomical differences described in the literature between cerithiopsids and triphorids do not justify their separation into two separate superfamilies.

In conclusion, study of the anatomy and radula of *Ataxocerithium eximium* and *A. scrupulosum* definitely excludes them from the Cerithiidae and supports their allocation to the Cerithiopsidae, superfamily Cerithiopsacea, near *Cerithiella* and *Triforis*. If it is shown that *Ataxocerithium* is a sister group to the latter two taxa, they may all comprise a separate clade within (subfamily Cerithiellinae) or separate from (Cerithiellidae) the Cerithiopsidae.

The genus *Ataxocerithium* needs much attention: current knowledge indicates that this genus is probably more complex than previously thought, and its exact composition and systematic position will remain uncertain until the entire complex is reviewed.

ACKNOWLEDGEMENTS

I thank Dr. Winston F. Ponder of the Australian Museum, Sydney for pointing out this species to me. I also thank Mr. Ian Loch, collection manager of the same institution, for the loan of the specimens. Mr. Bruce Marshall of the National Museum of New Zealand, Wellington, critically reviewed the manuscript and contributed valuable advice. Photography was done by Mr. Victor Krantz, Smithsonian Photographic Services. Ms Susanne Braden, Smithsonian Scanning Electron Microscope Laboratory, assisted with the SEM.

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